the light further redirected by the reflective element and returning the light along the optical path to the laser source whereby the optical path created by the laser source, the diffractive element and the reflective element causes the light to lase at the wavelength, and a rotatable electrostatic microactuator coupled to the reflective element for rotating the reflective element about a pivot point spaced apart from the microactuator to select the wavelength of the light.

A4 cont.

38. The tunable laser of Claim 37 further comprising a collimating lens disposed between the laser source and the diffractive element.

39. The tunable laser of Claim 37 further comprising a counterbalance coupled to the microactuator and the reflective element for inhibiting undesirable movement of the reflective element in response to externally applied accelerations to the reflective element.--

## REMARKS

The Supplemental Information Disclosure Statement filed July 6, 2001 does not appear to have been considered by the Examiner. A copy of the Supplemental Information Disclosure Statement, as well as a copy of the return postcard from the U.S. Patent and Trademark Office, are enclosed herewith. Applicant requests that the Examiner consider the Supplemental Information Disclosure Statement and acknowledge such consideration in the next Action.

Claims 12, 18, 19 and 31-34 have been rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 12 has been amended to delete reference to "the signal" and now refers to "the capacitance." In Claim 18, the "light beam" of Claim 16 is provided by "an additional laser source" such as source 206 in FIG. 4, while in Claim 19 the "light beam" of Claim 16 is provided by the "laser source" such as laser source 101 in FIGS. 5 and 6. The "laser source" of Claim 19 is the same laser source that provides the "light" of Claim 1. Both Claims 18 and 19 depend from Claim 16, and not from one another, and hence two laser sources do not provide the same light. With respect to Claims 31-34, Claim 31 has been amended to state that the adjustment of the optical path created by the laser source, the diffractive element and the reflective element causes the light to lase at a selected wavelength. Regarding Claim 34, the relationship of power of the output beam to the collimating lens is discussed on Page 34 of the application commencing at line 1, where it is stated:

> *The power of output beam 150 can also be monitored by any suitable power detector such as a photodiode (not shown) to permit positioning of collimating lens 503 so as to maximize such optical output power. Repositioning of collimating lens 503 may be desirable should the relative relationship of certain components of tunable laser 501, such as diffraction grating 504 and reflector 506, be improper due to initial*

*misplacement or due to the operational environment of tunable laser 501 or module 623. For example, variable temperatures, shock or vibration may result in undesirable misalignment of the diffraction grating 504 and/or the reflector 506 that can be corrected by repositioning collimating lens 503. In addition, nonperfect rotation of reflector 506 may also necessitate movement of collimating lens 503. In this regard, a power detector such as power detector 632 can be coupled to controller 561 and collimating lens 503 moved by second microactuator 508 until such measured output power is maximized. Movement techniques for collimating lens 503 can include periodic dithering of the lens 503 or periodic movements in accordance with other control schemes so that the collimating lens 503 is positioned relative to second beam portion 150b to enhance coupling of the beam 150 back into laser source 502.*

As discussed therein, adjustment of the collimating lens enhances coupling of the return beam into the laser source and can thus increases the power of the of the light. With the foregoing amendment and explanations, it is assumed that the rejection under 35 U.S.C. §112, second paragraph, will be withdrawn.

Claims 1-11, 14, 15, 18, 19 and 28-30 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Lang et al. (U.S. Patent No. 5,771,252) in view of the Akimoto et al. reference entitled *Micro electro mechanical systems (MEMS) and their photonic application* and Maeda (U.S. Patent No. 6,018,535). Claims 16, 17 and 20-22 have been similarly rejected as being unpatentable over Lang et al. in view of Akimoto et al. as applied to Claim 1 above and further in view of Mattori et al. (U.S. Patent No. 6,081,539) and Claims 26 and 27 have been similarly rejected as being unpatentable over Lang et al. in view of Akimoto et al. as applied to Claim 1 above and further in view of Broutin et al. (U.S. Patent No. 6,198,757). Reconsideration of these claims is respectfully requested.

Applicant acknowledges that Claims 13 and 23-25 have been indicated to be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claim 31 has been indicated to be allowable if rewritten to overcome the rejection under 35 U.S.C. §112, second paragraph, and Claim 34 has been indicated to be allowable if rewritten to overcome the rejection under 35 U.S.C. §112, second paragraph, and to include all of the limitations of the base claim and any intervening claims.

Claim 13 has been rewritten in independent form including the essential limitations of Claim 1 and is now assumed to be allowable. New Claims 35 and 36 depend from Claim 13 and are patentable for the same reasons as Claim 13 and by reason of the additional limitations called for therein. With the amendment to Claim 31 and the explanation regarding Claim 34 as part of the discussion of 35 U.S.C. §112, second paragraph, set forth above, it is assumed that Claims 31-34 are now allowable as written.

Lang et al. disclose an external cavity, continuously tunable wavelength source. FIG. 1B therein illustrates a Littman type configuration. In this configuration, laser diode 10 is combined to form an external optical cavity with a fixed reflective element grating 12 and rotatable reflective element 18, as indicated by arrow 20, to provide frequency selection feedback for laser diode 10. Col. 1, lines 39-43. Lang et al. are concerned with avoiding mode hopping between optical cavity longitudinal modes in an external cavity laser diode having an external cavity grating mirror. As part of their solution, Lang et al. disclose that the light source relies on the optical properties of the optical system at a single wavelength, and is characterized by a phase error curve comprising a cubic function with a single root having minimal deviation from zero near the root so that longitudinal mode hopping will not occur during tuning. See Col. 3, lines 57-62.

Akimoto et al. disclose a tunable laser diode (LD) with a Si micromirror in FIG. 5. The side walls of cantilever beam and each stator form capacitors for electrostatic actuation. When a driving voltage is applied between the cantilever beam and one of the stators, the beam is bent and attracted to that stator. Stator electrodes are located on both sides of the cantilever beams, so it can be moved in either direction. The amount of cantilever beam deflection is much smaller than its length, so the sidewall mirror remains almost parallel to the LD facet. The LD is bonded close to the cantilever beam because of its lens-less short-external-cavity configuration. Page 375. A short-external-cavity tunable LD having a Ni micromirror and a conventional LD chip is shown in FIG. 14. The LD is bonded about two microns from the mirror. The LD facet facing the mirror is anti-reflection coated. Page 380.

Claim 1, as amended, is patentable by calling for a single mode tunable laser of the type set forth therein having, among other things, at least one microactuator coupled to one of the diffractive element and the reflective element for moving such element to select the single wavelength of the light.

In rejecting Claim 1 over Lang et al., the Examiner acknowledges that Lang et al. do not disclose a micro-actuator for tuning the laser system to obtain different wavelengths. The Examiner further states that Akimoto et al. disclose the use of micro-electro mechanical systems technologies in tunable laser diodes and, therefore, it would have been an obvious to a person having ordinary skill in the art at the time the invention was made to apply the MEMS technologies disclosed by Akimoto et al. to the external cavity tunable laser of Lang et al. because the combination would provide a compact laser system with precise and accurate tunable wavelength range.

A proper analysis of the obviousness/nonobviousness of the claimed invention under 35 U.S.C. §103(a) requires consideration of two factors: (1) whether the prior art would have

suggested to those of ordinary skill in the art that they should carry out the claimed invention; and (2) whether the prior art would also have revealed that in so carrying out the claimed invention, those of ordinary skill would have a reasonable expectation of success. Both the suggestion and the reasonable expectation of success must be founded in the prior art, not in the applicant's disclosure. In re Sernaker, 217 U.S.P.Q. 1, at 5 (Fed. Cir. 1983); and In re Vaeck, 20 U.S.P.Q.2d 1438, 1442 (CAFC 1991).

In the present case, the rejection of the claims under 35 U.S.C. §103 is in error because Lang et al. fail to provide the requisite suggestion/motivation to provide a single mode tunable laser of the type called for therein having, among other things, at least one microactuator coupled to one of the diffractive element and the reflective element. The Examiner acknowledges that Lang et al. fail to disclose a microactuator. In addition, however, Lang et al. fail to disclose any actuator, let alone an actuator coupled to one of the diffractive element and the reflective element. A reader of Lang et al. is left to his or her imagination as to how movement of any of the elements therein should be accomplished.

Similarly, Akimoto et al. do not provide the requisite motivation to add a microactuator to a laser assembly of the type disclosed in Lang et al. For example, Akimoto et al. do not disclose a laser device having a diffractive element as called for in Claim 1. Nor do Akimoto et al. disclose a single mode tunable laser. Rather, Akimoto et al. merely disclose a device having a Fabry-Perot device with a linear translatable mirror element. As such, Akimoto et al. disclose a multi-mode laser device which tends to lase simultaneously at a variety of closely-spaced wavelengths. The difficulty, if not impossibility, of the Akimoto et al. device to operate at a single longitudinal mode is depicted in Fig. 15 thereof. As shown therein for a driving voltage of zero volts, for example, outputs are provided at 1539 nm, 1540.5 nm, 1541.3 nm, 1542.5 nm, 1543.5 nm and 1545 nm. It also appears from the data in Fig. 15 that the laser device disclosed in Akimoto et al. cannot be controlled adequately on a given longitudinal mode and, instead, spontaneously hops between adjacent modes when tuned over various voltages. Such behavior of the Akimoto et al. device makes it unacceptable for most commercial uses. The ability of the laser microassembly of Claim 1 to operate on a single frequency is an important feature of the invention and a significant challenge overcome by the inventors.

Even if a microactuator of Akimoto et al. was combined with a device of the type disclosed in Lang et al., there is no suggestion or disclosure in the prior art that in so carrying out such combination those of ordinary skill would have a reasonable expectation of success. As stated in the instant application beginning on Page 2, line 12 with respect to the disclosure of Lang et al.:

*The grating-based external cavity tunable laser (ECLs) of 5,771,252 is a relatively large, expensive device that is not suitable for use as a transmitter in a large-scale WDM network. Because of the size and distance between components, assembly and alignment of the prior art ECL above is difficult to achieve. Known prior art ECLs use stepper motors for coarse positioning and piezoelectric actuators for fine positioning of wavelength selective components. Because piezoelectric actuators exhibit hysteresis, precise temperature control is needed. In addition, prior art ECL lasers are not robust in the presence of shock and vibration.*

As noted above with respect to Akimoto et al., a single mode laser device is not disclosed therein. Furthermore, and as can be appreciated by those skilled in the art, the field of microactuator design is still nascent. Contrary to the belief of the Examiner, it cannot be assumed that any particular actuator configuration can be developed or is physically possible. Hence, there is no reasonable expectation that the inclusion of a microactuator in a tunable laser of the type disclosed in Lang et al. would be successful in producing a single mode tunable laser, let alone a single mode tunable laser as called for in Claim 1.

In view of the foregoing, the Examiner's rejection of Claim 1 as being obvious over Lang et al. in view of Akimoto et al. is improper and should be withdrawn. Claim 1 should be found allowable.

Claims 2-12 and 14-27 depend from Claim 1 and are patentable for the same reasons as Claim 1 and by reason of the additional limitations called for therein. For example, Claim 6 is additionally patentable by providing that the at least one microactuator includes a microactuator coupled to the reflective element for rotating the reflective element about a pivot point. There is certainly no disclosure in Akimoto et al. of such a microactuator, let alone a suggestion as to how such a microactuator could be developed and used to provide a single mode tunable laser. Claim 7 is additionally patentable by providing that the pivot point is spaced apart from the microactuator. Claim 9 is additionally patentable by providing that the at least one microactuator includes a first microactuator coupled to the reflective element for rotating the reflective element about a pivot point and a second microactuator coupled to the reflective element for translating the reflective element relative to the diffractive element The additional limitations of Claims 7 and 9 are not suggested or disclosed by the prior art.

Claim 28 is patentable by calling for a tunable laser of the type set forth therein having, among other things, a rotatable micromechanical actuator coupled to one of the diffractive element and the reflective element for rotating such element to select the wavelength of the light. Contrary to the assertion of the Examiner, Akimoto et al. do not disclose such a rotatable micromechanical actuator. Nor do Akimoto suggest or disclose such an actuator for use with a

tunable laser of the type disclosed by Lang et al. so as to provide a tunable laser as called for in Claim 28. As discussed above, the nascent nature of microactuator design precludes one from assuming that any particular micromechanical actuator configuration can be developed or is physically possible.

Claims 29-30 depend from Claim 28 and are patentable for the same reasons as Claim 28 and by reason of the additional limitations called for therein. For example, Claim 29 is additionally patentable by providing that the micromechanical actuator includes a rotatable micromechanical actuator coupled to one of the diffractive element and the reflective element for rotating and translating such element and Claim 30 is additionally patentable by providing that the micromechanical actuator includes an additional microactuator for translating such element. The additional limitations of Claims 29 and 30 are not suggested or disclosed by the prior art.

New Claims 37-39 are different in scope than the claims of record. Claim 37 is patentable for reasons discussed above by calling for a tunable laser comprising a laser source for providing light along an optical path with a wavelength selected from a range of wavelengths, a diffractive element positioned in the optical path and spaced from the laser source for redirecting the light received from the laser source, a reflective element positioned in the optical path and spaced from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back along the optical path to the diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light along the optical path to the laser source whereby the optical path created by the laser source, the diffractive element and the reflective element causes the light to lase at the wavelength, and a rotatable electrostatic microactuator coupled to the reflective element for rotating the reflective element about a pivot point spaced apart from the microactuator to select the wavelength of the light.

Claims 38-39 depend from Claim 37 and are patentable for the same reasons as Claim 37 and by reason of the additional limitations called for therein. For example, Claim 38 is additionally patentable by calling for a collimating lens disposed between the laser source and the diffractive element, while Claim 39 is additionally patentable by calling for a counterbalance coupled to the microactuator and the reflective element for inhibiting undesirable movement of the reflective element in response to externally applied accelerations to the reflective element.

Claims 1-3, 5-7, 10, 11, 14 and 15 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-3, 5, 7 and 9-12 of copending U.S. patent application Serial No. 09/491,429. In this regard, a Terminal Disclaimer with respect to U.S. patent application Serial No. 09/491,429 is enclosed and is assumed to overcome such provisional double patenting rejection.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with Markings to Show Changes Made."

In view of the foregoing, it is respectfully submitted that the claims of record are allowable and that the application should be passed to issue. Should the Examiner believe that the application is not in a condition for allowance and that a telephone interview would help further prosecution of this case, the Examiner is requested to contact the undersigned attorney at the phone number below.

Respectfully submitted,

DORSEY & WHITNEY LLP

By ______________________

Edward N. Bachand, Reg. No. 37,085

Four Embarcadero Center, Suite 3400
San Francisco, CA 94111-4187
Telephone: 650-494-8700

1049483

## VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the claims:

Amend the following claims as indicated:

1. (Amended) A single mode tunable laser comprising a laser source for providing light [with a wavelength] along an optical path with a single wavelength selected from a range of wavelengths, a diffractive element positioned in the optical path and spaced from the laser source for redirecting the light received from the laser source, a reflective element positioned in the optical path and spaced from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back along the optical path to the [reflective] diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light along the optical path to the laser source whereby the optical path created by the laser source, the diffractive element and the reflective element causes the light to lase at the wavelength, and at least one microactuator coupled to one of the diffractive element and the reflective element for moving such element to select the single wavelength of the light.

12. (Amended) The tunable laser of Claim 11 further comprising a controller for measuring the capacitance between the interdigitatable comb fingers and providing a drive signal to the at least one microactuator in response to the [signal] measured capacitance.

13. (Amended) [The] A tunable laser [of Claim 1 further] comprising a laser source for providing light along an optical path with a wavelength selected from a range of wavelengths, a diffractive element positioned in the optical path and spaced from the laser source for redirecting the light received from the laser source, a reflective element positioned in the optical path and spaced from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back along the optical path to the diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light along the optical path to the laser source whereby the optical path created by the laser source, the diffractive element and the reflective element causes the light to lase at the wavelength, at least one microactuator coupled to one of the diffractive element and the reflective element for moving such element to select the wavelength of the light and a

counterbalance [carried by the substrate and] coupled to the at least one microactuator and the one of the diffractive element and the reflective element for inhibiting undesirable movement of the one of the diffractive element and the reflective element in response to externally applied accelerations to the tunable laser.

28. (Amended) A tunable laser comprising a laser source for providing light [with a wavelength] along an optical path with a wavelength selected from a range of wavelengths, a diffractive element positioned in the optical path and spaced from the laser source for redirecting the light received from the laser source, a reflective element positioned in the optical path and spaced from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back along the optical path to the [reflective] diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light along the optical path to the laser source whereby the optical path created by the laser source, the diffractive element and the reflective element causes the light to lase at the wavelength, and a rotatable micromechanical [means] actuator coupled to one of the diffractive element and the reflective element for rotating [and translating] such element to select the wavelength of the light.

29. (Amended) The tunable laser of Claim 28 wherein the micromechanical [means] actuator includes [a microactuator for rotating such element] a rotatable micromechanical actuator coupled to one of the diffractive element and the reflective element for rotating and translating such element.

30. (Amended) The tunable laser of Claim [29] 28 wherein the micromechanical [means] actuator includes an additional microactuator for translating such element.

31. (Amended) A tunable laser comprising a laser source for providing light [with a wavelength] along an optical path with a wavelength selected from a range of wavelengths, a diffractive element positioned in the optical path and spaced from the laser source for redirecting the light received from the laser source, a reflective element positioned in the optical path and spaced from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back along the optical path to the [reflective] diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light along the optical path to the laser source whereby adjustment of the optical path created by the laser source, the diffractive element and the reflective element causes

the light to lase at [the] a selected wavelength, a collimating lens disposed between the laser source and the diffractive element and a microactuator coupled to the collimating lens for moving the collimating lens to enhance the return of the light to the laser source.

Add the following claim:

35. The tunable laser of Claim 13 wherein the at least one microactuator includes a microactuator coupled to the reflective element for rotating the reflective element about a pivot point.

36. The tunable laser of Claim 35 wherein the pivot point is spaced apart from the microactuator.

37. A tunable laser comprising a laser source for providing light along an optical path with a wavelength selected from a range of wavelengths, a diffractive element positioned in the optical path and spaced from the laser source for redirecting the light received from the laser source, a reflective element positioned in the optical path and spaced from the diffractive element for receiving the light redirected by the diffractive element and for further redirecting the light back along the optical path to the diffractive element, the diffractive element receiving the light further redirected by the reflective element and returning the light along the optical path to the laser source whereby the optical path created by the laser source, the diffractive element and the reflective element causes the light to lase at the wavelength, and a rotatable electrostatic microactuator coupled to the reflective element for rotating the reflective element about a pivot point spaced apart from the microactuator to select the wavelength of the light.

38. The tunable laser of Claim 37 further comprising a collimating lens disposed between the laser source and the diffractive element.

39. The tunable laser of Claim 37 further comprising a counterbalance coupled to the microactuator and the reflective element for inhibiting undesirable movement of the reflective element in response to externally applied accelerations to the reflective element.